SPRAY CALENDAR
WITH
SEED, SOIL AND DISINFECTION TREATMENT METHODS

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BULLETIN

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CALENDAR FOR THE TREATMENT OF PLANT DISEASES AND INSECT PESTS

PREPARED BY W. J. GREEN, A. D. SELBY AND H. A. GOSSARD

This calendar for the treatment of diseased conditions in plants is designed to cover the needs of farmers and horticulturists. It was first prepared at the request of the Ohio State Horticultural Society. Fungicides and insecticides may often be combined in spraying, and where Bordeaux mixture is used for fungus diseases, this practice is recommended. Spraying young orchards with Bordeaux mixture, lime-sulfur or other fungicides from time of planting, and of stocks in nursery row, is strongly recommended to preserve healthy conditions.

REMEDIES

FUNGICIDES

1 Bordeaux Mixture I.*

Copper sulfate (*blue vitriol*) 4 pounds.
Quicklime (*not air slaked*) 4 pounds.
(Of dry air slaked lime or hydrate of lime one-fourth more.)
Water to make 50 gallons.

Dissolve the copper sulfate in about two gallons of hot water, contained in a wooden vessel, by stirring, or even better by suspending the sulfate contained in a cheese cloth sack, in a large bucketful of cold water. With the cold water and cheese cloth bag a longer time is required. Pour the sulfate solution into the barrel or tank used for spraying, and fill one-third to one-half full of water.

*The strength of Bordeaux mixture best adapted to ones use upon apple trees, varies with the spray appliances employed; with hand pumps and low pressure of the spray a 4x4x50 formula may be used with safety, while with high pressure and heavy applications of spray a 3x3x50 strength is safer even in earlier sprayings—for later ones a greater strength than 2x2x50 is seldom desirable.

Slake the lime by addition of a small quantity of water, and when slaked, cover freely with water and stir. Pour the milk of lime thus made into the copper sulfate, straining it through a brass wire strainer of about 30 meshes to the inch. Pour more water over the remaining lime, stir and pour into the other; repeat this operation until all the lime but stone lumps or sand is taken up in the milk of lime. Now add water to make 50 gallons in the tank. After thorough agitation the mixture is ready to apply. The mixture should be made fresh before using, and any left over for a time should be thrown out or fresh lime added. In most operations on a large scale, and for uniform results from arsenicals added to Bordeaux mixture, *it is usually better to combine the diluted copper sulfate solution and the milk of lime diluted to volume in a mixing tank* before putting into the spray tank.

When in a small way separate barrels are used, and both the lime and blue vitriol are made up to equal measured volume, insecticides may be added in the lime barrel and the equal volumes run together directly into the sprayer.

2 Bordeaux Mixture II

Copper sulfate, 2 pounds.
Quicklime, 2 pounds.
(Of dry air slaked lime or hydrate of lime one-fourth more.)
Water to make 50 gallons.

For use on such trees as have foliage injured by Bordeaux I.

STOCK SOLUTION AND LIME PUTTY

A solution of copper sulfate, containing, say, one pound of sulfate to the gallon of water, may be made and permitted to stand indefinitely in a covered barrel if no lime is added. Such a solution is known as a stock solution and two or three or four gallons of this stock solution, according to the strength desired, is taken for each fifty gallons of the mixture to be made. For extensive spraying, a long trough or box of uniform width may be used, in which to slake and keep the lime. The quicklime is weighed out according to the amount needed, immediately placed in the trough and slaked with a small quantity of water. The whole is evenly spread and covered as a putty with water to exclude the air. This putty may be removed in calculated portions, placed in a tub and treated like the freshly slaked lime. By means of stock solution of copper sulfate and the lime in putty state, much valuable time is saved in filling the barrels or tanks used in spraying. (See mixing tank suggestions above.)

3 Ammoniacal Solution of Copper Carbonate

Copper carbonate, 6 ounces.
Ammonia, about three pints. (*Avoid excess.*)
Water, 50 gallons.

Dissolve the copper carbonate in the ammonia and add the water.

Caution—Use no more ammonia than is required to dissolve the copper carbonate. Ammonia is variable in strength, and the amount required must be tested in practice.

To make copper carbonate: Dissolve ten pounds copper sulfate (*blue vitriol*) in ten gallons of water, also twelve pounds of carbonate of soda in same quantity of water. When cool, mix the two solutions slowly, stirring well. Allow the mixture to stand twelve hours and settle, after which pour off the liquid. Add the same quantity of water as before, stir and allow to stand the same length of time. Repeat the operation, after which drain and dry the blue powder, which is copper carbonate.

4 Soda Bordeaux Mixture

Copper sulfate, 4 pounds.
Commercial caustic soda, soda lye, (*sodium hydroxid*) slightly in *excess* so that mixture is alkaline—according to strength, 1 lb. 5 oz. to 1 lb. 8 oz. by testing.
Water to make 50 gallons.

For use instead of ammoniacal copper carbonate.

Warning—In each case of change of grade or brand of commercial caustic soda, it will be necessary to test the strength. Keep the mixture well agitated. (See Bulletin 130.)

TO TEST THE STRENGTH OF CAUSTIC SODA

Provide materials and appliances described in Bulletin 130 and test carefully the reaction with both red and blue litmus. It is not safe to use this mixture without testing each lot of caustic soda used.

To keep caustic soda: After opening a container and testing, weigh out the entire contents into portions such as are needed to make a single spray tank of mixture; put in Mason jars under shelter, cover with a pint or so of water, and this portion is ready to be used as needed. Open packages of caustic soda will absorb water and increase in weight on standing; unopened packages will usually keep for a year or more.

5 Potash Bordeaux Mixture

Copper sulfate, 4 pounds.
Caustic potash, potash lye, (*potassium hydroxid*) 1 lb. 5 oz. to nearly 1 lb. 8 oz. as necessary for *slight excess*. (See Soda Bordeaux.)
Water to make 50 gallons.

For use like Soda Bordeaux mixture instead of ammoniacal copper carbonate.

Caution—Prepare like soda Bordeax, only after test of the strength of the caustic potash.

6 Copper Sulfate Solution

Copper Sulfate, 4 pounds.
Water to make 50 gallons.

Dissolve the sulfate as directed in Bordeaux I.

Caution—This solution will injure foliage. It can be used only before the buds open.

7 Bordeaux Mixture and Iron Sticker

Copper sulfate (*blue vitriol*), 2 pounds.
Iron Sulfate (*copperas*), 2 to 3 pounds.
Quicklime, 4 to 5 pounds.
(Of dry air slaked lime or hydrate of lime one-fourth more.)
Water to make 50 gallons.

Proposed and recommended as substitute for Bordeaux I upon most fruits in foliage and upon certain vegetables, including especially apples and potatoes. The iron sulfate is precipitated by the lime as hydroxid and serves as a dilution sticker. The spray is rusty colored by reason of this iron compound.

Note: A stronger 4-4-8-50 formula may be used on *apple*, *pear* and *plum* before blossoms open.

Caution—Do not leave solution of iron sulfate standing beyond a second or third day, better to make fresh for each day.

7½ Half-strength Bordeaux Mixture and Iron Sticker

Copper sulfate (blue vitriol), 1 lb.
Iron sulfate (copperas), 2 lbs.
Quicklime, 3 to 4 lbs.
Water to make 50 gallons.

For use in late spring and mid-summer applications, especially upon apple; also available on pear and raspberry. Is a safe carrier for arsenicals.

8 Potassium Sulfid Solution

Potassium sulfid (*liver of sulfur*), 1 oz.
Water, 3 to 4 gallons.

This solution will not remain unchanged. The potassium sulfid must be kept in a well stoppered bottle. This may be made by a similar process to that of No. 9.

9 Sodium Sulfid Solution

Commercial caustic soda, 2½ lbs.
Flowers of sulfur, 5 lbs.
After solution, water to make 50 gallons.

To make sodium sulfid at lowest cost: Place the caustic soda in a metal vessel and add a little hot water. Then stir in sulfur gradually, adding meanwhile hot water or applying heat. The chemical reaction will generate heat. With its progress the color will change from yellow to nearly brick red. No heat is required after complete solution unless lime be added. Don't add excess of water until the solution is effected. It may be made in quantity with external heat and kept during a day as stock solution. Excess of lime may be added with double and triple portions of sulfur to make the possible equivalent of lime-sulfur solution.

Caution—This solution is prepared for application on dormant trees. Care must be observed.

Upon foliage, as of peach, a strength greater than 1 lb. caustic soda to 2 lbs. sulfur is not to be recommended.

To make sodium sulfid for treating *seed potatoes*, use at the rate of 1 lb. caustic soda to 10 oz. sulfur for 36 gallons of solution.

10 Self-Boiled Lime-Sulfur Mixture

Stone lime (only), 10 lbs.
Flowers of sulfur, 10 lbs.
Water to make 50 gallons.

An 8–8–50 strength is also used.

It is best to prepare the mixture in large lots for at least 200 gallons of spray, using 40 lbs. lime and 40 lbs. sulfur—so as to get enough heat to produce a violent boiling for a few minutes. Place the lime in a barrel and pour on enough water (about 3 gallons to every 20 lbs.) to start the slaking of the lime and to hold up the sulfur. Then add the sulfur after working through a sieve to break up the lumps, meanwhile stirring thoroughly, and finally add enough water to slake the lime into a paste. Considerable stirring is necessary to prevent caking on the bottom. If mixture tends to become sticky, a little more water may be added. After the violent boiling produced by the slaking of the lime is over, the mixture should be diluted ready for spraying, or at least enough cold water added to stop the cooking—5 to 15 minutes being required for this, according to whether the lime is quick acting or sluggish. The intense

heat in boiling seems to produce the desired mechanical mixture of the lime and sulfur. If allowed to stand too long before dilution, the sulfur tends to unite with the lime, and at the end of 30 to 40 minutes enough reddish liquid is produced to burn peach foliage and even apple foliage in some cases. Strain through a sieve of about 20 meshes to the inch to remove coarse particles of lime, but all of the sulfur should be worked through the strainer. For the 10–10–50 strength, dilute to 200 gallons. For other strengths, use a different dilution. The large disc nozzles are successfully used in the application of this spray.

Proposed and recommended by W. M. Scott, U. S. Department of Agriculture, as a fungicide for use on peach trees in foliage. Also available on American and Japanese plums and upon all varieties of cherries.

Caution—While this may be used on the peach in foliage, and upon other fruits, care should be exercised in the preparation of the mixture to avoid the formation of soluble sulfids as by use of hot water or allowing to stand before dilution, since these result in foliage injury from the spray.

10½ Lime-Sulfur Solutions

Lime-sulfur solutions, either derived from commercial preparations or from home boiled concentrates, are often very useful fungicides. For dormant sprays these are the same as for San Jose scale treatment. For foliage applications, greater dilutions are required. Upon apple a dilution of 1 part of the concentrate of 32° B. is made with 40 parts of water.

These solutions are quite weak as fungicides and as foliage sprays have not proved satisfactory where strong germicides are required. They have been thus far better adapted to use in apple orchards. See Formulae 14-16.

11 Formaldehyde (Formalin) Solutions

For oats and wheat, 1 lb. or pint 40% formaldehyde to 40 or 50 gal. water.
For potato scab and rosette, ½ pint of formaldehyde to 15 gal. water.
For onion smut, 1 lb. of formaldehyde to 25 or 33½ gal. of water.
For soil drench, 2 lbs. or more of formaldehyde to 50 gal. of water.
See table of Seed and Soil treatments.

11½ Formaldehyde Gas

Commercial 40% formaldehyde, 3 lbs.
Potassium permanganate crystals, 23 ozs.
Sufficient for 1,000 cu. ft. of space occupied by crates or trays. [Maine Formula.]

Enclose open tiers or piles of slat crates filled with dry onions, potatoes, etc., in tight room or oiled tent of canvas buried in earth about the base. Generate the formaldehyde gas in a flat bottomed dish or pan of adequate capacity by placing one of the materials, as the liquid formaldehyde, in the pan, and adding the other the last thing before retiring. Then close tight and allow to remain closed 24 to 48 hours.

Proportionate or multiple unit amounts may be taken for smaller or larger enclosed spaces. Applicable to fumigation of seed potatoes for scab, sweet potatoes for rot troubles and to newly gathered, dry onions before storing for winter.

12 Corrosive Sublimate

Corrosive sublimate, 2 ounces.
Water, 15½ gallons.

Label POISON; used for potato scab and for disinfection.

To hasten solution, have druggist pulverize the sublimate.

SEED AND SOIL TREATMENTS

SEED OR PLANT	FOR WHAT TREATED	TREATMENT	METHOD OF TREATMENT
Amaranthus	Fusarium wilt	Same as Aster below.	
Aster	Fusarium wilt	Sterilize soil with steam.	Apply steam as under Cucumber.
Barley	Scab	Seed treatment	See wheat scab, also Bulletin 203.
	Smuts (Loose and Covered)	Formaldehyde or modified hot water	For covered smut, sprinkling with stronger formaldehyde as for oats is successful. For loose smut, soak seed enclosed in sacks four hours in cold water, let stand wet four hours more and dip five minutes in hot water at 130 degrees Fahr., or three degrees lower than for other hot water treatments.
Bean	Anthracnose	(See spray calendar)	
	Rhizoctonia	Sterilize soil	Sterilize soil with steam as under cucumber lettuce, etc., or drench with formaldehyde.
	Weevil	Bisulfid of carbon	Submit to fumes for twenty-four hours in air-tight vessel or chamber.
Beets	Damping off	As for Lettuce rosette.	
Begonia	Nematodes	Sterilize soil with steam.	Disinfect soil to be used by heating with steam as described under cucumbers.
Cabbage and Cauliflower	Black-leg	Reject diseased plants.	Throw out and burn plants showing disease on stems. Change beds each year. (See Bulletin 228.)
	Black-rot	Rotate beds and crops.	
	Club-root	Quicklime on soil	Apply stone lime (quicklime) preferably ground lime, before planting, at rate of 80 bushels per acre and work into the soil with suitable tools.
	Fusarium wilt or Yellows	Place seed beds on new soil each year. Rotate crop	Fusarium wilt is chiefly transmitted in the soil. Rotation of the crop is necessary. See Bulletin 228.
	Maggot	Bisulfid of carbon, tobacco dust or carbolic emulsion or solution of hellebore.	Make hole in soil near roots, pour in about a teaspoonful of bisulfid of carbon and fill holes with soil. Cover soil around stalks freely with tobacco dust once per week. Dilute one of the carbolic or coal tar sheep dips with 100 or more parts of water and pour one-half pint around the root after removing the earth from one side. Apply decoction of hellebore in same manner.
	Nematodes in hothouse	Sterilize soil with steam.	See Cucumber.
Corn	Dry-rot & Mold	Reject diseased seed ears	This fungus spreads badly in continuous corn growing. See Bulletin 214.
	Ear-rots	Reject diseased seed ears	Same as Dry-rot of corn.
Cucumber	Nematodes in hothouse	Sterilize soil with steam	Sterilize soil with steam by perforated pipes, high pressure 1 to 2 hours, or low pressure in sub-drains 4 to 5 hours.
	Stink bug	Hand-picking eggs	Pick off patches of brownish eggs on leaves and burn. Go over the vines 2 or 3 times per week.

SEED AND SOIL TREATMENTS—Continued

SEED OR PLANT	FOR WHAT TREATED	TREATMENT	METHOD OF TREATMENT
Cucumber	Root-rot	Drench soil with formaldehyde	Drench soil with formaldehyde, 3 to 4 lbs. to 50 gallons of water for preceding lettuce crop.
	Wilts	Sterilize bed soil with steam	Method as for Nematodes
Egg-plant	Wilts	Sterilize bed soil with steam	Method as for Nematodes.
Lettuce	Aphis	Tobacco smoke	Smudge for several hours by burning tobacco stems or leaves in closed greenhouse or use nicotine fumigant.
	Rosette	Sterilize soil with steam or drench with formaldehyde	Steam as above or drench with formaldehyde 1½ to 2 lbs. where trouble follows with cucumbers 3 to 4 lbs. to 50 gallons of water, 1 gallon solution to each sq. ft. of surface. Two weeks must elapse before setting plants. See Circular 57.
	Drop or Rot	Steam soil	
	Slugs and Snails	Toads, poisoned bait, lime, soot	Turn number of toads in greenhouse to devour slugs. Use poisoned bran bait recommended for cutworms. Mulch ground quite freely with ground lime or with soot.
Muskmelon	Wilts	As for cucumber wilts	
Oats	Anthracnose	Formaldehyde	Treat seed as stated in next to kill adhering spores. This is only a partial remedy.
	Loose smut	Sprinkle seed with formaldehyde or immerse seed in hot water. Soak seed in potas. sulfid	Preferably sprinkle a pile of seed with shoveling to saturate with formaldehyde solution, one gallon to a bushel, at three or four sprinklings; after three or four hours or over night in the pile, spread to dry. Immerse seed contained in open vessel for ten minutes in hot water at 132-3 degrees Fahr., for seven minutes at 136 degrees Fahr., or for five minutes at 140-2 degrees Fahr., spread at once to dry. Soak seed in ¾ percent solution potassium sulfid for twenty-four hours with stirring, then dry.
	Insects in stored grain	(See wheat) Bisulfid of carbon	Fumigate soon after storing in bins. See formula 27.
Onion	Maggot	See treatment under cabbage and cauliflower.	
	Smudge	Use formaldehyde as for onion smut	Sow seed with formaldehyde as for onion smut; rotate onions with other crops.
	Smut	Use formaldehyde or ground quicklime. Plant other crop. Use sets or transplanted seedlings	Use formaldehyde solution 1 lb. to 30 gallons of water sprinkled on seed in contact with soil and cover at once, or better sow with drill and dip attachment, the solution falling with the seed. Or apply ground quicklime at the rate of seventy-five to one hundred and twenty-five bushels per acre just previous to seeding on freshly plowed land, and stir into soil. (See Bulletin 131.)
	Storage rots	Disinfect with formaldehyde gas	Fumigate to disinfect the dry onions, with formaldehyde gas in enclosed piles of slat crates for a period of 24 to 48 hours. (See description of method under No. 10 above.)
Pea	Anthracnose (Blight)	Spray the growing crop with Bordeaux	Keep down infection of seed through spraying of plants. See Spray Calendar.

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SEED AND SOIL TREATMENTS—Continued

SEED OR PLANT	FOR WHAT TREATED	TREATMENT	METHOD OF TREATMENT
Pea	Weevil	Heat in oven	Submit seed to heat of 125 degrees F. for one hour, at end of which time all weevil will be dead and germination will not be injured.
Potato	Black-leg	Reject tubers of diseased hills at harvest	Treat seed tubers with formaldehyde as for scab to kill adhering germs.
	Fusarium wilt, Dry-rot	Cut away slight infection of seed tubers — then soak in formaldehyde. Rotation of crops	After rejecting badly diseased tubers, cut off slight infection and treat with formaldehyde as for scab. Rotate the potato crop. (See Bulletin 229.)
	Scab	Soak uncut seed in formaldehyde or corrosive sublimate	Soak seed for 2 hours in formaldehyde or 1 hour in corrosive sublimate; then dry and plant on scab-free soil; formaldehyde gas may be used.
	Scab Gnat	Ditto as for scab	Treat seed before storing in cellar in fall.
	Rosette (Rhizoctonia)	Soak seed in formaldehyde as for scab	Soak seed in formaldehyde as for scab; on infected soil use formaldehyde after manner in onion smut. (See Bulletin 145, or Handbook of Plant Diseases.)
Radish	Club-root	Quicklime on soil	As for cabbage, etc.
	Damping off	Drench beds with formaldehyde or sterilize with steam	See tobacco bed treatment.
Roses	Nematodes in hothouse	Sterilize soil with steam	Heat soil with steam as described above; thoroughly disintegrated soil from sod one year or more old is less dangerous. Lime water stimulates affected plants but is not a remedy.
Rye	Anthracnose	Formaldehyde	Treat seed as for oats and wheat to kill spores. Remedy only partial.
Sweet Potato	Black-rot and Stem-rot	Formaldehyde	Soak or fumigate seed roots as for potato scab; discard old diseased hotbeds; drench slightly diseased beds with formaldehyde as for lettuce and tobacco. Then set plants on new soil.
Tobacco	Root-rot and Bed-rot	Drench beds with formaldehyde or sterilize with steam	Drench beds in fall or early spring with formaldehyde, 2 lbs. or more to 50 gals. water, 1 gallon to each sq. ft. Do not seed until smell of formaldehyde has disappeared.
	Tobacco worms in shed	Bisulfid of carbon	If necessary, fumigate housed tobacco to destroy worms carried into barn from field.
Tomato	Nematodes in hothouse	Sterilize soil with steam	As for roses and cucumbers above.
	Point-rot in hothouse	Mulch or sub-water	An insufficient water supply seems favorable to development of point-rot of green tomatoes.
	Rhizoctonia	Same as for tobacco beds	
	Fusarium wilt	Sterilize bed soil with steam	Transplant plants into new soil. Avoid succession of crops of tomatoes.

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SEED AND SOIL TREATMENTS—Continued

SEED OR PLANT	FOR WHAT TREATED	TREATMENT	METHOD OF TREATMENT
Turnip	Club-root	Quicklime in soil	As for cabbage and cauliflower. Avoid succession of these crops.
Violet	Nematodes in hothouse	Heat soil with steam	The time for prevention is by soil treatment beforehand as for cucumbers above.
Wheat	Anthracnose	Formaldehyde	Sprinkling as for stinking smut may prove partial remedy. Avoid use of infected straw on wheat fields. (See Bulletin 203.)
	Loose smut	Modified hot water	Soak seed four hours in cold water, let stand four hours more in wet sacks, immerse five minutes in water at 133 degrees Fahr. and dry, or sprinkle with formaldehyde after soaking.
	Scab	Reject Scabbed grain	Separate shriveled grain with sieves and mill. Sow only heavy seed grain. (See Bulletin 203.)
	Stinking smut	Formaldehyde, hot water or copper sulfate	Sprinkle grain in piles with formaldehyde as for oat smut, 1 gallon or less per bushel and dry in same manner. Dip skimmed seed for ten minutes in hot water at 133 degrees Fahr. and dry on disinfected surface or immerse ten minutes in solution of blue vitriol (copper sulfate); dry with air-slaked lime by shoveling. Use two pounds of blue vitriol to ten gallons of water. Grain may be sprinkled in piles with copper sulfate or formaldehyde as for oats. (See Bulletin 97.)
[illegible]	Insects in stored grain	Bisulfid of carbon	Place three pounds of bisulfid of carbon for each 2,000 pounds of grain in bins. Cover surface with blanket to hold the fumes which will spread through the mass, killing the insect life. Use in tight bins or buildings and do not use near fire of any description.

INSECTICIDES

13 Kerosene Emulsion

Laundry soap (chipped), ½ pound.
Kerosene (coal oil), 2 gallons.
Water (preferably soft and free from dirt particles), 1 gallon.

Dissolve the soap in the full amount of water and when this solution is boiling hot, remove from the fire and add the kerosene. Stir the mixture violently by driving it through a force pump back into the vessel until it becomes a creamy mass that will not separate. This requires usually from five to fifteen minutes. For use, dilute one part of the emulsion with 8 or 10 parts of water for winter use on scale insects and for hard bodied insects like the chinch bug. For soft bodied insects, such as plant lice, lice on animals, etc., use one part emulsion to 15 or 20 parts of water. The stock emulsion will keep good for months if kept in air tight vessels.

Kerosene emulsion kills by *contact*, and therefore, the application should be very thorough. It may be used against a great many different pests, but is especially valuable for destroying those with sucking mouth-parts, for they cannot be killed with arsenical poisons.

Caution—Only the dilute emulsion, 1 part emulsion to 15 or 20 of water, should be used when the trees are in leaf, and in all cases it should be kept thoroughly stirred; otherwise the foliage or even the twigs will be injured. Applications of this insectitude are much safer if made only on dry, sunshiny days, preferably with a light breeze blowing, so as to hasten evaporation, and thus minimize danger to the plants.

14 Lime-Sulfur Wash

Stone lime, 15 to 20 pounds.
(Hydrate of lime one-fourth more.)
Flowers of sulfur, 15 pounds.
Water, 50 gallons.

Slake the lime in a small quantity of hot water, gradually adding and stirring in the sulfur. Dilute mixture with twelve gallons of water and boil in an iron kettle or cook by steam in a covered tank or barrel for one hour or longer. Fill with water to the required 50 gallons. Strain the wash through a fine mesh strainer and apply hot. In using an iron kettle, keep the mixture vigorously boiling and thoroughly stirred to prevent caking and burning of the materials. Wash, cooked by steam, is more easily prepared and better made.

Apply wash in spring before buds open or in fall after leaves drop. Cover all parts of the tree with a heavy coat of the wash. If a single application is made per year for scale insects, especially for San Jose scale, it is advised that the treatment be given in the early spring. Where infestation is excessive, one spraying should be given in the fall after the leaves drop, and a second the following spring before the leaves appear. Also in case of large orchards it may be necessary to commence work in the fall so as to insure its completion before vernation in spring. Cover every bit of bark on every tree to insure success.

This remedy is perfectly safe in anybody's hands, if used during the dormant period. It is also a fungicide and controls peach leaf curl as well as San Jose scale.

This is one of the early formulae for making lime-sulfur solution. The only objection to it is the great quantity of sediment which must be removed by straining. Even when carefully strained, it frequently clogs pumps and nozzles

with accumulations of dirt. Notwithstanding this drawback, some of our best orchardists have returned to its use after a few years' trial of the commercial mixtures, being convinced that it is more effective for controlling scale insects.

For further details see Bulletin 169, Ohio Agricultural Experiment Station.

15 Home-made Concentrated Lime-Sulfur Solution

To make a concentrated solution of lime-sulfur at home, which will be largely free from sediment and approximate the commercial mixtures in physical properties, proceed as follows:

Lime, 50 pounds.
Sulfur, 100 pounds.
Water, 70 to 75 gallons.

Boil with steam or with fire. If fire is used, build it inside a suitable protection so wind cannot interfere with a steady blaze, thereby preventing a steady heat. If possible, provide two boilers, especially if the cooking is done with fire, keeping one for boiling water. A measuring stick graduated in gallons up to the capacity of the cooker will be found a great convenience. Have an accurate pair of scales and weigh the ingredients carefully. Place in the cooker enough water (15 to 20 gallons) to partially cover 50 lbs. of stone lime and heat to the boiling point, or nearly to it, then put in 50 lbs. of the best quality obtainable of fresh stone lime, free from air-slaked material and other impurities. As soon as the lime is slaking well, add 100 lbs. of sulfur and stir vigorously, mixing it thoroughly with the lime, gradually adding hot water the meanwhile, so as to keep a thin paste of the mixture. When all the lime has slaked, add enough water to increase the volume of the mixture to about 70 or 75 gallons. Keep this mixture at the simmering point and stir constantly until all the lime and sulfur are dissolved. This should be in a half-hour or a little more. Do not allow the volume to fall below 65 gallons at any time and occasionally examine a dipperful to ascertain if the constituents have gone into solution. When finished, strain into a suitable container and allow to cool. When cool, put in barrels and keep as nearly air-tight as possible. If intended for use in a short time, barrels may be left unsealed, but should be covered over, at least loosely, and some cheap animal oil may be put on top to exclude the air. For use in winter against scale insects, peach curl, etc., dilute 1 gallon with 5 gallons of water. This will be about the equivalent of the commercial brands diluted with 1 to 8 or 10 with water. For summer use on apples in leaf, dilute 1 gallon of this concentrated mixture with 18 gallons of water. This strength, (4 lbs. of dissolved sulfur in each 50 gallons of diluted spray) is approximately the equivalent of the best commercial brands diluted 1 to 30. If these directions are carefully followed, a hydrometer test is hardly necessary. However, hydrometer readings may be taken and dilutions made according to the table given with 16. For use on peaches and stone fruits in leaf, this solution should be diluted with about 40 to 50 parts of water.

16 Commercial Lime-Sulfur Solutions.

These are very convenient to use, being free from sediment and requiring no preparation other than stirring into water. When properly made and properly diluted, these mixtures are thoroughly reliable. The most convenient method for diluting the mixtures is by the hydrometer test. According to the determinations made by the New York State Experiment Station, Bulletin 330, the following table shows the dilutions that should be made with the respective readings of the Beaume hydrometer, assuming that the ingredients consist of only lime, sulfur and water, with a neglible quantity of impurities derived alone from the lime and the sulfur.

TABLE OF DILUTIONS FOR DORMANT AND SUMMER SPRAYING WITH LIME-SULFUR MIXTURES

Reading on hydrometer	Number of gallons of water to one gallon of lime-sulfur solution	
	For San Jose Scale. Winter use	For Summer spraying of apples
Degrees Beaume		
35	9.00	45.00
34	8.75	43.50
33	8.25	41.25
32	8.00	40.00
31	7.50	37.50
30	7.25	36 25
29	6.75	34.25
28	6.50	32.75
27	6.00	31.00
26	5.75	29 50
25	5.25	27.75
24	5.00	26.00
23	4.50	24.25
22	4.25	22.75
21	3 75	21.25
20	3.50	19.75
19	3.25	18.25
18	3.00	17.00
17	2.75	16 00
16	2 50	15.00
15	2 25	14.00
14	2.00	12 75

17

The self-boiled lime-sulfur solution No. 10 when used as a fungicide on trees in leaf has a very perceptible effect in reducing the numbers of aphids and in destroying newly hatched scales. Its value as an insecticide is considerable.

18 Soap Solutions.

One or two pounds of fish oil soap dissolved in one gallon of water makes a good spray to use against San Jose scale in winter, but is not as effective or cheap as other remedies. One pound of fish oil soap or laundry soap, in 4 to 7 gallons of water is good against plant lice.

19 Soluble or Miscible Oil.

Some commercial houses make brands of oil that readily emulsify with cold water and are used in winter at different dilutions for San Jose scale and also as summer applications. Some of these are valuable, and if used with care, are recommended as worthy of trial.

20 Paris Green.

In combination with Bordeaux mixture, Paris green may be used at the rate of one pound in from 100 to 150 gallons.

When Bordeaux mixture is unnecessary, the Paris green may be used at the same rate, but two or three pounds of freshly slaked lime must be added to prevent burning of the foliage. Keep the mixture well stirred so that the poison will be distributed evenly.

In cases where successive sprayings are necessary, it is important to consider the accumulation of the poison and use a slightly weaker mixture, unless sufficient rain has fallen to thoroughly wash off the poison.

21 Arsenate of Lead.

Arsenate of soda, 4 ounces.
Acetate of lead, 11 ounces.
Water, 3 to 5 gallons.

Dissolve the ingredients separately, each in one-half to one gallon of warm water. Mix together and pour into spray tank containing from 50 to 100 gallons of water. Add the milk of lime from two or three pounds of freshly slaked stone lime.

This poison is in many respects the most satisfactory for spraying purposes of any of the arsenicals. It is more adhesive than Paris green and, if properly made of good materials, will burn foliage but little, no matter what strength is used. These remarks especially apply to the commercial brands on the market, which are, in some respects, more satisfactry than the home-made product. While costing more than Paris green, arsenate of lead is generally regarded as more economical in the end because of its superior sticking quality and, hence, greater efficiency. For most purposes, 3 pounds of the commercial product in 50 gallons of spray are used. Either water, Bordeaux mixture, No. 7, or lime-sulfur solution may be used as the carrier.

22 Arsenite of Soda.

Dissolve two pounds of commercial white arsenic and four pounds of carbonate of soda (washing soda) in two gallons of boiling water and use from one quart to three pints to a barrel of Bordeaux mixture (50 gallons).

Orchardists often use one pint of this poison with the addition of one and one-half pound of commercial arsenate of lead in 50 gallons of Bordeaux for spraying apples. Results seem as good as when full strength arsenate of lead is used, except that more burning of the leaves occurs.

The easiest way to make the solution is to put both the white arsenic and carbonate of soda in a gallon of boiling water and keep boiling about fifteen minutes, or until a clear liquid is formed, and then dilute to two gallons for stock solution.

Caution—This cannot be used alone safely, but must be applied in Bordeaux mixture or No. 7. It is not so safe as arsenate of lead in lime-sulfur.

23 Arsenite of Lime.

White arsenic, 1 pound.
Lime, 2 pounds.
Water, 3 gallons.

Boil together for fully 40 minutes after the boiling point is reached. As a precaution against danger of burning, slake an additional pound of lime, add to it three or four gallons of water, and add to the boiled mixture. Strain and dilute to from 200 to 250 gallons for hardy vegetation such as potatoes. Do not use at all on stone fruits or on cucurbits. Dilute to 300 or 400 gallons for tender vegetation.

24 White Hellebore.

Because of quickly losing its poisonous properties, hellebore may be employed to spray fruits a few days before harvest when arsenical sprays would be dangerous. Use one ounce to three gallons of water.

25 Pyrethrum.

Pyrethrum is usually applied as a powder, with a bellows. but may be used as a spray at the rate of one ounce to two gallons of water. Poisonous

to insects but not to higher animals. Can be used on ripening fruits. By closing up rooms containing flies and mosquitoes, then filling the air full of the dust by means of a blow-gun, and keeping closed for several hours, preferably over night, most of the insects will be either killed or stupified and will drop to the floor. It is then easy to sweep them up and burn them.

26 Tobacco Decoction.

Boil one pound of tobacco stems or tobacco dust in one gallon of water for about one hour. Strain to remove dirt that would clog nozzle and add water to make two gallons of spray for each pound of tobacco used. Excellent for plant lice and does no injury to the most tender plants. Some of the commercial decoctions or preparations of nicotine are better than the home-made ones.

27 Bisulfid of Carbon.

This is a convenient fumigant for treating granaries, bins and closed compartments which contain stored grain, groceries and foodstuffs being injured by insects. Make the compartment as tight as possible by pasting paper strips over cracks, calking window fittings with rags, etc. When everything is made tight, pour the liquid poison into shallow containers and set on top of the grain, using about 3 lbs. or 3 pints for every 1000 cubic feet of space enclosed in the bin; or pour the liquid directly over the grain. A good way to distribute the liquid for rapid and effective action is to fit a stick loosely into a piece of gas pipe of suitable length and thrust this into the grain at various places and to different depths. Withdraw the stick, the purpose of which is to prevent the grain from rising in the pipe, and for each thrust pour one-fourth pint of liquid into the pipe. After the dosage has been completed, close the outside door and make tight in every way possible; a convenient method of doing this is to tack a wet horse blanket over the door, fastening it around the margins with lath strips. Keep closed for 48 hours. Do not bring a lighted match, lantern or cigar near the bin while fumigation is in progress as this gas is highly inflammable. Two or three treatments at intervals of a few weeks apart are advisable in case of bins at all open. Fumigation according to these directions will not injure grain for either feed or seed. This material is also excellent for fumigating woolens and furs infested with clothes moths. Place the article to be fumigated in a tight chest or trunk and saturate a sponge or mass of cotton with the carbon bisulfid at the proportions given above. Leave the chest closed for forty-eight hours or more, and if the goods are to be stored, place in tight chests or sew in paper bags. Carbon tetrachloride can be substituted for carbon bisulfid, but it should be used in approximately double the amounts. It has the advantage of not being inflammable, and hence is much safer for household use.

28 Poisoned Bait for Cutworms, Grasshoppers, Slugs, etc.

Cutworms are quite readily destroyed by a poisoned bran bait made as follows:

With 25 to 35 pounds of wheat bran, thoroughly mix, while dry, one-half pound of Paris green or an equal weight of powdered white arsenic. Dilute one quart of any cheap syrup with two or three gallons of water and mix with the bran and arsenic. Add enough more water to wet all the bran, but do not have it sloppy when ladeled. The exact proportions are not important and in making up small lots, it is customary to stir in just enough Paris green to give

to the mixed product a faint tinge of green, then sweetened water is added until the mass is of the right consistency. This bait is scattered over infested lands in little heaps, which keep moist longer if covered with pieces of board; the cutworms are more apt to find the poison when thus hidden, since they retreat to such locations for hiding during the day. A teaspoonful of the mixture put at the base of each garden plant liable to attack will afford good protection. If the plants are in drilled rows, a line of the bait may be placed along each side of the row. It is always best when possible, to put the bait in gardens when freshly plowed, before the crops are planted; the worms finding nothing above ground to eat but the bait, feed on it greedily and are destroyed before the crop is planted.

Another good bait for cutworms and grasshoppers is obtained by spraying a patch of clover or other succulent vegetation with Paris green, one-half pound to fifty gallons of water, or with arsenate of lead, 3 pounds to 50 gallons of water. A few hours after spraying, the poisoned grass is cut with a scythe or mowing machine and scattered in little heaps over the infested land. These piles should be made large enough to prevent rapid drying out of the under portions, or the grass may be placed under boards like the bran test.

29 Criddle Mixture for Grasshoppers.

This has been used very successfully in the Canadian provinces and in some of the States for destruction of young gasshoppers on a large scale. This is a mixture of horse droppings, salt, Paris green and water. The efficacy of the mixture depends upon the liking of these insects for salt. To prepare the mixture, take 100 lbs. of horse droppings, preferably fresh, two lbs. of salt and one lb. Paris green or an equal quantity of white arsenic or else three pounds of arsenate of lead. One and one-half bushels of horse manure by measure is about right, if it is inconvenient to weigh the material. Use only the droppings free from straw and litter. Stir the poison into a gallon or so of water and then with a fork, hoe or other suitable utensil, mix all the ingredients together in a barrel, gradually adding a pailful of water as mixing proceeds. Water should not be added in sufficient quantity to cause dripping when the mass is ladeled. The salt may be dissolved in the water before it is added. A large shovelful of the mixture is used for every three or four square rods, being placed in heaps of a shovelful each, about two rods apart, each way. If it is wished to intercept the migration of the grasshoppers into a special field, protection is secured by putting shovelsful of the mixture a rod apart around the borders of the field. This remedy is most effective if used in early Summer but is of considerable value later in the season for the half-grown and adult insects. So far as reported, poultry and valuable birds are not endangered by this remedy.

SPRAY CALENDAR*

WHAT TO SPRAY	FOR WHAT TO SPRAY	WITH WHAT TO SPRAY	WHEN TO SPRAY				REMARKS AND CAUTIONS
			First Spraying	Second Spraying	Third Spraying	Fourth Spraying	
Alfalfa	Leaf spot	Possibly Bordeaux on seed crop	Bordeaux spraying at intervals of 2 or 3 weeks				Can be used only on seed crop.
	Sclerotium wilt	Remove and burn infected stools	Remove on sight, roots and all				
Apple	Canker	Prune, remove diseased parts, dress with asphaltum 300° M. P.	Cut out and burn cankers or diseased branches. Treat wounds with asphaltum melting point 300° F.				Blister Canker is a wound parasite. Wound dressings of all but very smallest pruning wounds with asphaltum required when active.
	Bitter rot	Bordeaux II or No. 7½ and Ammoniacal Cop. Carbonate	With first appearance of rot about July 1st Bord. II or No. 7½	One to two weeks after first Ammoniacal Copper Carbonate	Two weeks later	Not required if Bordeaux precedes.	
	Blotch	Bordeaux II or No. 7½ and Ammoniacal Cop. Carbonate	July 1st Bordeaux II or No. 7½	Two weeks later Ammoniacal Cop. Carb.	Two to three weeks later		These follow sprays for scab; danger on fair-skinned apples.
	Black rot	Probably 7½ on red apples	Same as bitter rot				These sprays follow spraying for scab.
	Frog eye	Same as bitter rot and blotch	See bitter rot				For black rot follow scab sprays closely, using Bordeaux and Iron Sticker as long as safe.
	Rust	Same as scab and bitter rot	Same as scab and bitter rot				
	Scab	Bordeaux I or 7, or lime-sulfur	Just before blossoms open, Bordeaux I	Just after blossoms drop, I, No. 7 or lime-sulfur	Same 7 to 10 days later.	Rarely needed.	The spray just before the blossoms open is very essential for scab. Bordeaux advised for first on varieties susceptible to scab. On Ben Davis and Baldwin lime-sulfur good for second and third.
	Sooty fungus	No. 7½ or Bord. II	After blossoms drop (see scab)	Two weeks later	Same as Bordeaux for scab	Bordeaux II or No. 7	Midsummer copper sprays needed where lime-sulfur is used early in season (see blotch)

*For seed and soil treatment see page 28.

SPRAY CALENDAR—Continued.

WHAT TO SPRAY	FOR WHAT TO SPRAY	WITH WHAT TO SPRAY	WHEN TO SPRAY				REMARKS AND CAUTIONS
			First Spraying	Second Spraying	Third Spraying	Fourth Spraying	
Apple continued	Twig blight...	Cut out and burn..	Cut out and burn on appearance.....	.....	.....	.....	Bacterium lives over in blight cankers.
	Bud moth	Arsenicals in Bord. or lime-sulfur solution	With opening of buds..				
	Canker worm..	Arsenate of lead alone.....	With first young worms	2 or 3 days later if worms remain.....	Same as second.	.....	20, 21 or 22 in Bordeaux are not quite as efficient as arsenate of lead alone.
		Band with tree tanglefoot.....	.....	.....	.....	. .....	Bands should be in place by Feb. 15th.
	Blister mite (see pear)....						
	Codling moth..	Arsenites or arsenates in Bordeaux I or 7 or lime-sulfur solution with arsenate of lead 3 lbs. to 50 gallons.....	As soon as blossoms fall.....	7 to 10 days later.....	Second week in July...	Last week in July. Arsenate of lead alone on light colored apples..	
	Curculio.....	Same as above.....	Same as above.....	Same as above.....	Same as above.....	Same as above..... ..	
	San Jose scale.	Lime-sulfur or 19....	Late in winter, early spring or late in fall.	.....	... .	....	In case of bad infestation spray in fall and repeat in spring
	Oyster shell scale..... Scurfy scale.	Lime-sulfur Kerosene emulsion or 19.	Early spring with 14.	June 1 to 15 with lime-sulfur or 13 or 19.....	For oyster shell scale Aug. 1 to 15 with 13 or 19		
	Woolly aphis ..	Kerosene emulsion...	When trees are in full leaf.....	In fall.		....	Dont use strong emulsion or oil when trees are in full leaf.
...ster	Fusarium wilt.	See seed and soil treatment					
	Blister beetle	Whale oil soap, or dilute chloro-naphtholeum.....	When beetles appear.	. ...	.. ..	... .	Use 1 pound soap to 6 gallons water.
Asparagus.. ..	Asparagus beetle.	Air-slaked lime or pyrethrum as a powder.....	When larvae appear...	Same as first.....	Same as first	Same as first.....	Do not use arsenicals, except in late summer.
	Asparagus rust.	Bordeaux I.... ..	After cutting crop.....	Ten days later.... ..	Ten day ater.....	Ten days later.....	Repeat 3 or 4 times. Burn rusted brush in fall.
Bean.....	Anthracnose...	Bordeaux I	Soak seed one to two hours in am. cop. carb. 5 times strength of 3.....	Bordeaux on 2 or 3 in. plants.....	Bordeaux 10 days later	After blossoms.	Repeat if needed.

SPRAY CALENDAR—CONTINUED.

WHAT TO SPRAY	FOR WHAT TO SPRAY	WITH WHAT TO SPRAY	WHEN TO SPRAY				REMARKS AND CAUTIONS
			First Spraying	Second Spraying	Third Spraying	Fourth Spraying	
Bean continued	Rust	Burn old plants	Destroy diseased pods				Select resistant varieties.
Beet	Leaf spot	Bordeaux I	When plants are 5 to 6 inches high	Two weeks after first	Two weeks later		
	Damping off	See soil treatment					
Cabbage and Cauliflower	Black leg	See soil treatment					
	Cabbage worm	Pyrethrum	With first appearance of worms	Whenever worms are observed	Same as second	Same as second	1 oz. to 30 gallons water or dust 1 to 10 of flour.
	Club root	See soil treatment					
	Yellows	See soil treatment					
	Maggot	See soil treatment					
	Downy mildew	Bordeaux mixture					
Carnation	Leaf or calyx mold	Bordeaux 1 or ½ or 6.	Upon appearance of fungus	Two weeks later	Two weeks later	Repeat if needed	Begin early before the calyces are ruined
	Leaf spot	Bordeaux 1 or ½ or 6.	Upon appearance of fungus	Two weeks later	Two weeks later	Cover foliage well	
Catalpa	Leaf spot	Bordeaux I	Upon appearance of fungus	2 or 3 weeks later	Repeat if necessary	Cover foliage well	
Celery	Leaf spot or leaf blight	Bordeaux I	On young seedlings	Repeat on seedlings	Before or after transplanting	Two weeks later	Keep leaves well covered in plant bed.
	Root rot	Drain soil					
Chard	Leaf spot	See beet leaf spot					
Cherry stocks	Leaf spot	Bordeaux II or No. 10	When leaves are half grown	Two weeks later	Two weeks later	About two weeks later.	
Cherry	Leaf spot, Mildew	Bordeaux II or No. 10	When leaves are unfolding	Two weeks later	2 or 3 weeks after second		First after blossoming. Often necessary to treat repeatedly after crop is gathered.
	Rot	Bordeaux I and II	Before blossoming I	After blossoms drop, II on fruit	Two weeks later II on fruit	2 weeks later, II, 3 or 4	Use 3 or 4 when fruit is large. No. 10 on sweet cherries.
	Aphis	Soap solution	On first appearance of aphis				Difficult to reach aphis Use 1 lb. of soap to 4 gallons of water.
	Cherry slug	Arsenate of lead in Bordeaux I or self-boiled lime-sulfur	After fruit harvest when slugs appear	Repeat if slugs remain			Air-slaked lime may be used when trees are carrying fruit.

SPRAY CALENDAR—Continued.

WHAT TO SPRAY	FOR WHAT TO SPRAY	WITH WHAT TO SPRAY	WHEN TO SPRAY				REMARKS AND CAUTIONS
			First Spraying	Second Spraying	Third Spraying	Fourth Spraying	
Cherry	Curculio	Arsenate of lead in Bordeaux I and II or in self-boiled lime-sulfur	Before blossoming in I.	As blossoms dry up in II	One week later in II		Avoid strong solutions. Do not use other arsenicals than arsenate of lead.
	San Jose scale	14 or 19	Before buds open.				
Chestnut	Bark disease	Cut out and burn diseased parts					Disease not yet known in Ohio. This is for warning
	Leaf spot	Bordeaux I	When leaves are half grown	Three weeks later.			
	Weevil	Roast nuts in fall					Heat nuts in fall to 135° F. for 1 to 2 hours.
Cineraria	Mildew	Bordeaux I or ½ or 6.	When mildew appears in spring	Two weeks later.	Repeat if necessary.		
Chrysanthemum	Leaf spot	Bordeaux II or ½ of 6	July 1	Two weeks later.	Repeat if necessary.		
Cottonwood	Beetle	See poplar.					
Cucumber	Anthracnose	Bordeaux I	When plants begin to vine	Two weeks later.	Two weeks later.	Two weeks later.	Repeat as necessary.
	Downy mildew	Bordeaux I	July 25 to August 1	Eight to ten days later	Eight to nine days later	Eight days later	Repeat at weekly intervals
	Root rot	(See soil treatment)					
	Spot of fruit	Bordeaux I	After first blossoms	Ten days later	Two weeks after second	Two weeks after third.	Apply to fruit carefully.
	Nematodes	(See soil treatment)					
	Wilts	(See soil treatment)	Pull out and burn infected plants				Rotate crops.
	Cucumber beetle	Arsenate of lead in Bordeaux I. Or sprinkle and mulch freely with tobacco dust	Soon as plants appear.	Week later.	Week after second	Week after third	Week after fourth.
Currant	Leaf spot	Bordeaux I	As leaves are unfolding	Two weeks later.	Two weeks later.	2 or 3 weeks later.	Fourth necessitates washing fruit.
	Plant bug	Kerosene emulsion or 19	May	Early in June if necessary.			
	San Jose scale	Lime-sulfur or 19	As with the apple.	In spring as with apple			
	Worm	White hellebore arsenate of lead	When worms first appear. Arsenate of lead when in bloom.	In 3 or 4 days repeat.	Repeat as second		Look for worms on under side of leaves first.
Egg plant	Bacterial blight	Remove and burn					

SPRAY CALENDAR—Continued.

WHAT TO SPRAY	FOR WHAT TO SPRAY	WITH WHAT TO SPRAY	WHEN TO SPRAY				REMRAKS AND CAUTIONS
			First spraying	Second spraying	Third spraying	Fourth spraying	
Elm..	Leaf spot.....	Bordeaux I..... ..	When leaves are half grown.....	Three weeks.later.....			
	Powdery mildew.	Lime-sulfur or Bordeaux.....	With first appearance of mildew in midsummer.....	Three weeks later.....			
	Flea beetle....	See potato					
	Lecanium scale	As maple for terrapin scale.....					
	Leaf beetle.....	Ars. of lead 1 lb. to 10-15 gals., also bands of burlap and tanglefoot; band below.....	When larvae appear...	.....	.....	.....	Repeat every 3 weeks until disappearance.
Ginseng.....	Alternaria blight	Bordeaux I.....	As new stools appear..	Two to 3 weeks later..	Repeat second.....	Repeat if necessary...	
Gooseberry....	Leaf spot.....	Bordeaux I.....	As currants with leaf spot.....	As currants with leaf spot.....	As currants with leaf spot.....	As currants with leaf spot.....	
	Mildew.....	Bordeaux I or 8.....	Before leaves open I...	After blossoming I....	Potassium sulfid two weeks later.....	....	Bordeaux coats fruits if used for 3rd. Sodium sulfid may be substituted for 8.
	Worm.....	White hellebore or arsenate of lead....	As on currants.....				
Grape	Anthracnose ..	Bordeaux 1	Just before buds open..	Just before blossoming	Just after fruit has set	10 days later Bordeaux	
	Berry moth....	Arsenate of lead with Bordeaux 1 or 7....	Before bloom.....	After fruit has set.....	July 1 to July 15.....		
	Downy & powdery mildew.	Bordeaux 1 or 7....	Just before blossoming	After fruit has set.....	10 to 15 days later. .		
	Necrosis	Bordeaux 1	In early spring coat vines and trunks well	Repeat with next rot spray.			
	Rot.....	Bordeaux 1 or 7 and 3 or 4..... ...	Just before blossoming Bordeaux 1 or 7.....	Just after fruit has set 1 or 7.....	7 or 8 days later.....	7 or 8 days later, Bordeaux 1 or 7.....	Follow by two or three sprayings with Soda Bordeaux or am. cop. carbonate.
	Leaf hopper ...	Kerosene emulsion, 19 or strong tobacco decoction.....	Before young can fly...	.....	....	....	Repeat treatments at short intervals until insects are exterminated.

SPRAY CALENDAR—Continued.

WHAT TO SPRAY	FOR WHAT TO SPRAY	WITH WHAT TO SPRAY	WHEN TO SPRAY				REMARKS TO SPRAY
			First spraying	Second spraying	Third spraying	Fourth spraying	
Grape	Rose bug	Arsenate of lead and glucose in water	Soon as bugs appear	2 or three days later	1 week later	1 week later	Continue at intervals of 1 week or oftener as long as necessary.
Horse Chestnut	Leaf spot or blight	Bordeaux 1	When leaves are half grown	Two weeks later	Two weeks after second	2 or 3 weeks later.	
	Leaf hopper	Tobacco decoction or dilute kerosene emulsion	As soon as noticed, before insect acquires wings	Repeat first 10 days later.			
Juniper or Cedar	Rust	Cut out rust apples	As soon as seen, better in fall.				
Lettuce	Downy mildew	Keep houses cool and avoid water on leaves					Warmth and moisture are dangerous. Sub-irrigation gives ideal conditions.
	Rosette or Rot or drop	See soil treatment	Gather diseased leaves				
Maple	Caterpillars	Arsenicals	When seen.				
	Borers	Whitewash trunks					Keep trunks whitewashed from early summer till fall, 2 or 3 applications.
	Terrapin scale	Kerosene emulsion 1 part to 6 or 8 parts water or miscible oils 1 part to 12 parts water	When buds are swelling				
Muskmelon	Anthracnose	Bordeaux I and II	In seed bed or when plants begin to vine				
	Cucumber beetle	Same as for cucumbers	Bordeaux II	2 weeks later Bord. 1	Two weeks later	Two weeks later	Repeat as necessary; use II very early.
	Downy mildew	Bordeaux 1	July 25 to August 1	8 to 10 days later	8 or 9 days later	Eight days later.	
	Leaf blight	Bordeaux 1	When plants begin to vine	Three weeks later	3 weeks after second	Two weeks after third	Repeat same.
	Wilts	See soil treatment	Pull out and burn wilted plants				
Oak	Anthracnose	Bordeaux I or 14	Just as buds are opening I or 14	Two weeks later if necessary.			
	Caterpillars	(See maple)					
Oats	Anthracnose	(See seed treatment)					
	Blade blight	Soap solution or kerosene emulsion	When green fly appears	Two weeks later.			
	Smut	(See seed treatment)					

SPRAY CALENDAR—Continued.

WHAT TO SPRAY	FOR WHAT TO SPRAY	WITH WHAT TO SPRAY	WHEN TO SPRAY				REMARKS AND CAUTIONS
			First spraying	Second spraying	Third spraying	Fourth spraying	
Onion	Smut, Storagerots	(See seed treatment)					
Pea	Blight, Mildew	Bordeaux I	Just before bloom	Two weeks later	Repeat if needed.		
Pine	Blister rust	Remove and burn					Remove and burn infected seedlings, etc.
	Damping off	See tree seedlings					
	Bark louse (woolly)	Kerosene emulsion 1 to 8	On trunk and larger limbs.				
	Leaf scale	Kerosene emulsion 1 to 10 or 12					
Peach	Leaf curl	Bordeaux I, 6 or 14	In fall, or March, Bordeaux I, 6 or 14	As buds are opening, I, 6 or 14	Just after calyx drops, Bordeaux II	Not required, ditto 3rd, if others are well done	Lime-sulfur for first instead of Bordeaux I when scale is present.
	Little peach	Prune severely or dig out					
	Pustular spot	Bordeaux II or 10	Just after calyx drops	Two weeks after first	Two weeks later		Cover fruit well.
	Rot	Bordeaux I, 14 and 10 or Bordeaux II	As buds are swelling, 1 or 14	Just after calyx drops, 10 or Bordeaux II	3 or 4 weeks later, 10	As fruit begins to color 10	Every 7-10 days repeat. Destroy all mummies. 3 may be used 4th.
	Scab	Bordeaux I, 6, 10 or 14	As buds are swelling, Bordeaux I, 6, 8 or 14	Just after calyx drops, 10 or Bordeaux II	2 weeks later, 10 or Bordeaux II, 8 or 9	Repeat third	10 is safest remedy in foliage.
	Yellows	Cut out and burn					
	Bud moth	Arsenicals in Bord I	With opening of buds				Use only half usual amount of poison.
	Curculio	Arsenate of lead and self boiled lime sulfur	Arsenate of lead 10 days after bloom falls	Self boiled lime-sulfur and arsenate of lead 10 days later.			
	Terrapin Scale	As on maple					
Pear Stocks	San Jose scale	Lime-sulfur	In late fall or early spring.				
	Leaf spot or blight	Bordeaux 1	When leaves are half grown	Two weeks later	Two weeks later	Two weeks later	5 to 7 sprayings are needed.

SPRAY CALENDAR—Continued

WHAT TO SPRAY	FOR WHAT TO SPRAY	WITH WHAT TO SPRAY	WHEN TO SPRAY				REMARKS AND CAUTIONS
			First spraying	Second spraying	Third spraying	Fourth spraying	
Pear	Leaf blight	Bordeaux 1 or 7 and 3 or 4	Before blossoms open	Two weeks later, 1 or 7	2 weeks after second	Bordeaux may make russet fruit	Use 3 for 3rd, not Bordeaux after 2nd. Bordeaux after second may injure the fruit.
	Scab	Bordeaux I	When leaves are half grown	After blossoms drop.			
	Blister mite	Kerosene emulsion, miscible oil or lime-sulfur	When buds begin to swell in spring	When leaves have fallen in autumn.			
	Bud moth	Arsenites in Bord. I.	With opening of buds				
	Canker worm	Arsenate of lead					See apple.
	Codling moth	Arsenicals in Bord. I.	As with the apple	Same as first			See apple.
	San Jose scale	Lime-sulfur or 19	In winter or early spring				
	Slug	Arsenicals in Bord. I or dust with slaked lime	When slugs appear	Repeat if slugs remain.			
Plum	Pockets or Bladders	Bordeaux I or Lime-sulfur	In March, I or 14				Treat as for leaf curl of peach.
	Rot	Bordeaux I, also 3 or 4 No. 10 on Am. and Jap. varieties	As buds are swelling, I or 14	Just after calyx drops 1 or 7.	Three or four weeks later, I or 7	As fruit begins to color use 3 or 4	Every 7-10 days repeat 4th; useless to spray for rot, unless mummies are destroyed.
	Shot-hole fungus	Bordeaux I or 7, also No. 10	When leaves are half grown	Three weeks later	3 weeks later if needed	No. 10 on Am. and Japanese varieties	Protect to end of season.
	Curculio	Arsenate of lead in Bordeaux I or self boiled lime-sulfur	With starting of buds	Just after calyx drops.	Five days later		Jar, gather and destroy curculios and stung plums in addition.
	Aphis	Soap solution	On appearance of aphis				Use 1 lb. soap to 6 gal. water.
Poplar or Cottonwood	San Jose scale	Lime-sulfur or 19	In late fall or early spring				
	Cottonwood leaf beetle	Arsenate of lead 1 lb. to 10 gallons water.	Spray at intervals of 10 days until danger is checked.				
Potatoes	Black leg	See seed treatment.					

SPRAY CALENDAR—Continued.

WHAT TO SPRAY	FOR WHAT TO SPRAY	WITH WHAT TO SPRAY	WHEN TO SPRAY				REMARKS AND CAUTIONS
			First spraying	Second spraying	Third spraying	Fourth spraying	
Potatoes	Early blight	Bordeaux I or 7	When plants are 6 in. high	Two weeks later.	Two weeks later.	Two weeks later if needed.	Seed selection desirable.
	Fusarium blight	(See seed treatment).					
	Late blight	Bordeaux 1 or 7	July 15-20	Two weeks later.	Two weeks later.	Two weeks later.	Repeat at two-week intervals until crop is mature.
	Rosette	(See seed treatment.)					
	Blister beetle	Whale oil soap or dilute Chloro-naphtholeum	When beetles appear.	Repeat if necessary.			Use 1 lb. soap to 6 gal. of water.
	Colorado beetle	Arsenicals alone or in Bordeaux I	When beetles or young appear	As for first.	As for first.		Arsenate of lead, 3 lbs. to 50 gallons of water, for Colorado beetle alone.
	Flea beetle	Bordeaux I or 7 combined with 21	When beetles appear.	Repeat if necessary.	As for first and second		
Quince Stocks	Leaf spot	Bordeaux I	When leaves are half grown	About two weeks later	Two weeks later.	Two weeks later.	Perhaps 5th spraying will be needed.
Quince	Leaf spot	Bordeaux I and 7	When leaves are half grown		Two weeks later, I or 7	Two weeks later.	First should come before blossoms open.
	Fruit and leaf spot	Bordeaux I	Just before blossoms open	After blossoms drop.	Two weeks after second	Two weeks later.	
	San Jose scale	Lime-sulfur or 19.	In late fall or early spring				
Radish	Club-root	See soil treatment.					
	Maggot	See soil treatment.					
Raspberry and Blackberry	Anthracnose	Bordeaux I and II	Before leaves open use I	II on canes 6 in. high.	Repeat 2nd one week later.		Keep spray from leaves of bearing canes.
	Cane blight	Bordeaux II	On young canes just before blooming of old	Immediately after fruit is gathered	Three weeks after 2nd		Remove old canes at once after picking and spray new canes very thoroughly.
	Leaf-spot	Bordeaux I	When leaves are half grown	Two weeks later.	Two weeks later.		Be prompt in destroying diseased stools.
	Rust	Remove diseased stools and burn					
	Rasp. Byturus	Arsenate of lead	Before beetles appear; about May 1st.	May 10th to 15th.			Cultivate thoroughly in fall to destroy and expose pupae.
	Saw fly	Pyrethrum, hellebore or arsenate of lead.	As for currant worm. Arsenate of lead as soon as leaves are out	In 3 or four days repeat			
Rose	Leaf-spot	Bordeaux I or ½ of 6.	With first appearance of fungus.	2 or 3 weeks later.	Repeat if necessary.		Bordeaux shows on plants.

SPRAY CALENDAR—Continued.

WHAT TO SPRAY	FOR WHAT TO SPRAY	WITH WHAT TO SPRAY	WHEN TO SPRAY				REMARKS AND CAUTIONS
			First spraying	Second spraying	Third spraying	Fourth spraying	
Rose	Mildew	Lime-sulfur as for apple or No. 10	With first appearance of mildew	2 to 3 weeks later	Three weeks later if needed		When Bordeaux is used for leaf-spot, other spray may not be needed.
	Nematodes	See soil treatment.					
	Slug	Arsenicals in Bord. II or hellebore	On appearance of slugs	Repeat if needed.			
Rye	Anthracnose	See seed treatment.					
	Ergot	Remove ergotized grain before seeding					
Salsify	Cystopus	Remove and burn diseased parts					
Squash	Cucumber beetle	Same as for cucumber					
	Squash bug	Hand picking					Pick bugs and egg-masses from leaves. Trap bugs by laying shingles beneath vines and collecting insects the following morning.
Strawberry	Leaf-spot	Bordeaux 1, 7 or 10	On new growth after crop	2 or 3 weeks later.			
Sugar Beets	Damping off	See soil treatment					
	Leaf-spot	Bordeaux I	With first appearance of spots	2 or 3 weeks later	2 or 3 weeks later	3 weeks later if needed.	
	Blister beetle	Whale oil soap or dilute Chloro-naphtholeum	When beetles appear				Use 1 lb. to 6 gallons of water.
Sycamore	Anthracnose	As for oak.					
	Powdery mildew	Lime-sulfur or No. 10	With first appearance, about July 15	Three weeks later on new growth	Repeat second		Most troublesome on oriental variety.
Tobacco	Root-rot and bed-rot	See soil treatment.					
	Mosaic disease	Handle separately from healthy plants					Communicated by touching. See Bulletin 156.
	Tobacco worm	Paris green or arsenate of lead	When worms appear	2 weeks later	2 or 3 weeks later if necessary		Powdered arsenites applied with powder gun are most satisfactory.
Tomato	Anthracnose	Bordeaux I	Soon after fruit begins to set	3 weeks later	weeks later		

SPRAY CALENDAR—Concluded.

WHAT TO SPRAY	FOR WAAT TO SPRAY	WITH WHAT TO SPRAY	WHEN TO SPRAY				REMARKS AND CAUTIONS
			First spraying	Second soraying	Third spraying	Fourth spraying	
Tomato..	Fusarium wilt	See soil treatment. Rotate crop.....	. ...	.. . .	.. ..	....	Rotate crop.
	Leaf blight...	Bordeaux I	3 weeks after transplanting.....	3 weeks after first.....	3 weeks later	3 weeks later.	
	Mosaic disease (in greenhouse).....	Avoid too high temperatures at night	Watch carefully and ventilate fully.	.. ..	. .....	....	Deficient ventilation makes this serious.
	Point rot	See soil treatment.					
	Sclerotium wilt	Remove and burn diseased plants.....	Watch carefully.....	....	.....	....	Danger in refuse from diseased houses.
	Tomato worm.	Hand picking.....					
Tree Seedlings (Conifers)	Damping off...	Slaked lime dust 10 parts, powdered copper sulfate 1 part, thoroughly mixed and screened	Dust freely on young seedings in afternoon.	Repeat first	Repeat first	.....	Very strong Bordeaux mixture as 6-6-50 may be useful in bad, advanced cases.
Turnip.....	Downy mildew.	Spray with Bordeaux mixture.....	Upon appearance of disease.	2 to 3 weeks later ...			
Watermelon ..	Anthracnose ..	Bordeaux II.....	When plants begin to vine..	Three weeks after first	3 weeks later	3 weeks later....	Bordeaux I, some danger.
	Cucumber beetle..... ..	Same as for cucumber					
	Downy mildew.	Bordeaux II.....	July 25 to Aug. 1	8 to 10 days later.	8 to 9 days later.		
	Leaf blight....	Bordeaux II.... ..	As disease appears on muskmelons	Repeat as on muskmelons.....	As on muskmelons ...	As for cucumbers.	
Wheat.....	Anthracnose, scab, smut, etc	See seed and soil treatment.					
☞	Insects in stored grain....	See seed treatment page 31.					

SPRAY MIXING AND FILLING OUTFITS

"Time saved is money earned," and in nothing is this more certain than in spraying. The old directions for making spray mixtures contemplate simply the minimum of labor or time saving devices. *With large orchards, time saving devices become imperative.* Of these, special arrangements to facilitate rapid filling of the spray tanks are very helpful. Here are some essentials for Bordeaux mixture and conveniences for other sprays:

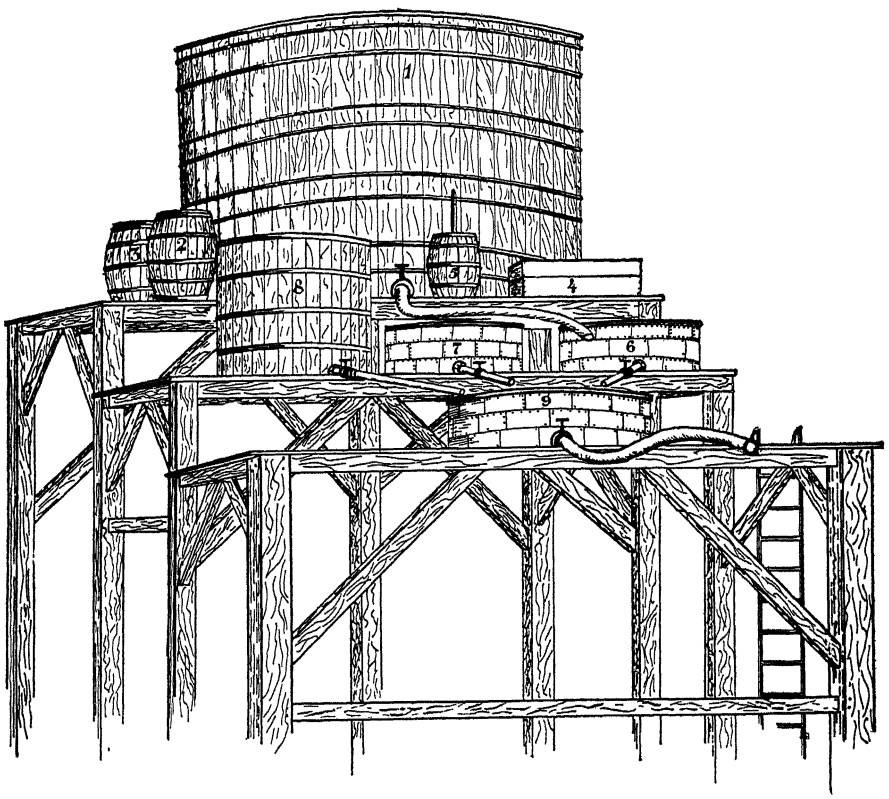

Figure 1. Adapted illustration of a complete Spray Mixing and Filling outfit.

No. 1. Large tank at elevation filled from eavestroughs of building or by pump, provided with outle and valve with attached hose. No. 2. 50-gallon barrel for stock solution or copper sulfate. No, 3. Same for iron sulfate. No. 4. Lime box to contain lime in putty form. No. 5. Arsenate of lead mixer to prepare the paste by mixing with water before addition to lime tank. No. 6. Lime tank of 50 to 100 gallons capacity wherein the lime putty is diluted and made up to volume desired after counting volume of arsenicals added in it. No. 7. Tank of 50 to 100 gallons capacity for copper sulfate and iron sulfate. In this, the solutions are made up to half the capacity of sprayer or equal volume with milk lime and ready to be mixed with it. If of metal, this tank should be painted inside to reduce precipitation of copper on the metal. No. 8. Wooden tank for steam cooking of lime-sulfur by means of a boiler located nearby. No. 9. Mixing tank into which the copper sulfate, etc., and milk of lime are run in equal volumes for mixing. It also serves as a dilution tank for lime-sulfur prepared by steam cooking in No. 8.

Note: Tanks Nos. 6 and 7 should be of known volume, or say, half the capacity of the spray tank used. Tank No. 9 needs to be double the capacity of 6 and 7, or equal to the capacity of the spray tank. (From Drawing by Wm. P. Beeching, Jr.)

Adequate water supply in tank or reservoir above the level of the mixing platform—as by a tank filled from eaves-troughs of high barn, or by lifting with pump.

2. Accessible supplies of spray material upon the same level as that on which the mixing is done—as covered storage for chemicals and barrels containing stock solutions of blue vitriol, iron sulfate, lime tank, etc.

3. A separate mixing tank, preferably of low, flat form above level of spray tank, in which the spray materials are thoroughly mixed before being run into the spray tank. This results in a terraced group of platforms at different levels, each carrying its proper tanks and barrels. Fig. 1.

4. For lime-sulfur with arsenate of lead, a tank filling pump or tank filler may be successfully used to fill the sprayer from a ditch or other reservoir. This may be of type operated by power on spray outfit.

Those who have used arsenate of lead have experienced the difficulty of getting the lead to mix after it has settled to the bottom of the package, or after it has partially dried out. Frequently the mixing of the lead requires as much time as any of the other processes in preparing a sprayer full of mixture. We have found that an old churn is very efficient for the process, and if one is not available, a substitute may be made quite readily from a discarded hundred-pound arsenate of lead keg, or any keg of similar size. In making the churn, have the lid fit snugly, and it is preferable if the cross arms of the dasher are almost as long as the inside diameter of the bottom of the keg.

In cooking lime-sulfur, either for the formula No. 14 or for the making of concentrates, the need for special devices is apparent to everyone. These have been well illustrated in Bulletin No. 169 and in Bulletin No. 144. The former bulletin is available upon application. In figure 1, the smaller wooden tank, No. 8, is designed for cooking lime-sulfur by means of steam from a boiler; the larger mixing and dilution tank, No. 9, is available for the dilution of the lime-sulfur.

In field work, especially in southern Ohio, where water supplies of adequate amount have not been very generally developed, a portable mixing outfit will serve very well as a substitute for the more highly developed, expensive, fixed ones. The illustration, figure 2, shows one of these mounted upon wheels such as are used for binder trucks, and of the necessary elevation of frame to admit running from the barrels directly into sprayer. The tank filler pump is useful in connection with this for lifting the water.

The larger illustration, Fig. 1, shows the details of a complete mixing plant adapted somewhat from that used at Orchard Farm, Mansfield, Ohio, L. D. Twitchell, Mgr. It is presented to illustrate how the numerous materials, apparatus, etc., may be assembled and readily operated without relifting of the water or the spray solutions. The prime need is a sufficient water supply in the tank, either by gathering from a building or by pumping into the tank. This once attained, the other details may be arranged at different levels, whereby the liquids are run from one or several sources into the lower receiving tank and thence into the sprayer.

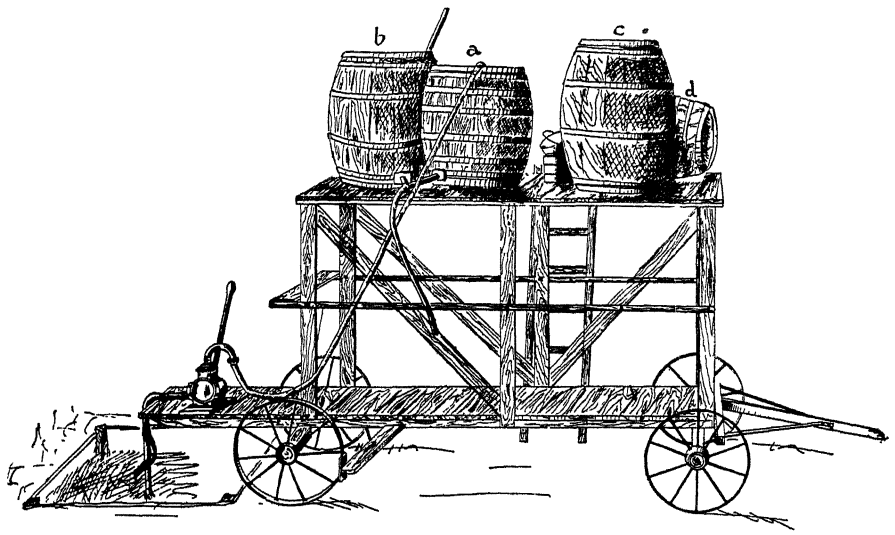

Fig. 2. A Portable Mixing Outfit.

The above illustration is redrawn from the photograph of a portable mixing plant in use in Southern Ohio. Barrels A and B are used for the dilute copper sulfate and lime-lead arsenate mixture, respectively. Barrel C is used for the concentrated copper sulfate stock solution and D may be used for iron sulfate or a water supply for rinsing, etc. The water is elevated from the spring by the use of the strong hand pump. (From Drawing by Augustus Bonazzi after photograph by J. S. Houser.)

In all of these spray mixing outfits, the first essential is that the one lifting of water or the reservoir supply of water shall place it at such height above the sprayer to be filled that no relifting and rehandling of the liquids is necessary. For the more expensive outfits this is done by the fixed water tank which is filled by power, etc. For the inexpensive, portable ones, the fundamental idea is to have a frame of sufficient height that when the liquid is lifted or pumped into the barrels supported by this frame, these supplies shall be at the necessary elevation for running directly into the sprayer itself. Of course, in portable outfits the spray materials have to be carried about, and in proportion as the quantity is large, difficulties of that kind will appear.

For lime-sulfur concentrates to which arsenate of lead is added, the difficulty in this respect is very slight, and by use of the arsenate of lead mixer above described, the filling may be done directly with the tank filling pump from any available water supply.

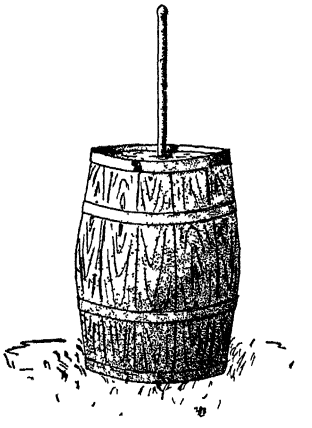

Fig. 3. Arsenate of lead mixer. A mixer for working up arsenate of lead paste. An old churn may be utilized; but if this is not available, a mixer may be made from a small keg. (From Drawing by Augustus Bonazzi.)

CONCERNING SPRAY OUTFITS

In selecting a spraying outfit, care should be taken to purchase only machines which seem to have the qualities of durablity, simplicity and sufficient capacity for the use of the average orchardist. The kind and quality of materials used in the construction, together with the sufficient strength of parts and the quality of the workmanship, largely determine the durability of the pump, if the design is good. Only brass or bronze or other non-corrosive working parts will resist corrosion by the sprays. Parts liable to give trouble should be readily accessible so that they can be easily removed and repaired. Large bronze ball valves and fairly large air chambers are desirable features. Hose leads should be at least 35 feet long with extra long hose connections and two hose bands at each end. Extension rods should be preferably of bamboo, lined with brass or aluminum tubes, and about ten feet in length. Cutoffs, preferably of the leakless type, are needed at the bases of the rods. Vermorel nozzles of double and quadruple patterns are generally satisfactory, but disc nozzles usually are to be preferred to the other types, especially on power outfits.

With hand pumps, as well as with power sprayers, it is desirable, in addition to an air chamber of at least 3 to 7 gallons capacity, to have a pressure gauge and to apply the spray under conditions of uniform pressure. If the pump is really a desirable kind it will bear the added expense of the pressure gauge. A pressure of 100 pounds or over for hand outfits, and up to 200 pounds on power sprays has been found desirable.

For further discussion of spraying machinery, see Bulletin 216. Nozzles and spraying machinery accessories will be covered in a future publication of this Station.